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(54) **PITCH AGNOSTIC BUS-BAR WITH PITCH AGNOSTIC BLIND MATE CONNECTOR**

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H01R 25/14 (2006.01)

(52) **U.S. Cl.**
CPC ***H01R 25/142*** (2013.01)

(58) **Field of Classification Search**
USPC 439/116, 120–122, 517, 843, 845
See application file for complete search history.

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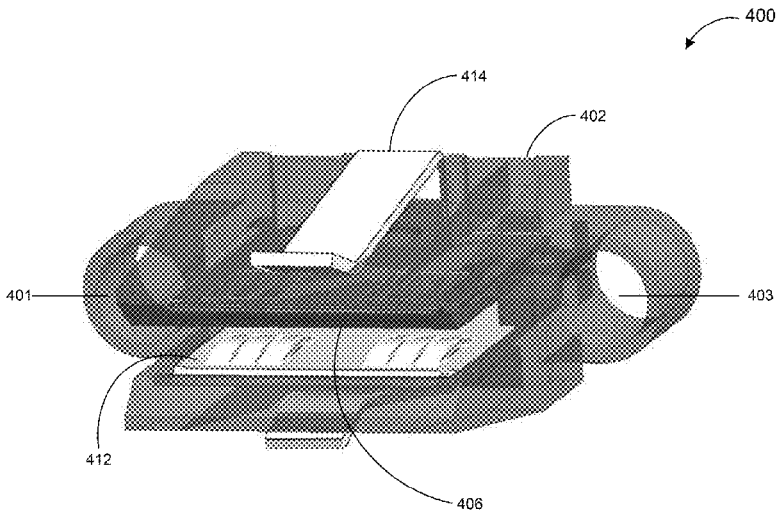
(57) **ABSTRACT**

The present disclosure provides various bus bar connectors configured to draw power from a bus bar at non-discrete locations. In one aspect, a bus bar connector may include a connector housing having a slot. The slot may be configured to allow the connector housing to grip a bus bar at different locations. First and second electrical contacts may be disposed on opposite sides of the slot. The bus bar connector includes mounting members for securing the connector housing against an enclosure for the bus bar and a spring clip that can be to attach to upper and lower outer surfaces of the connector housing to provide an amount of contact force onto the outer surface of the connector housing. The amount of contact force enables the first and second electrical contacts to securely grip the bus bar.

20 Claims, 8 Drawing Sheets



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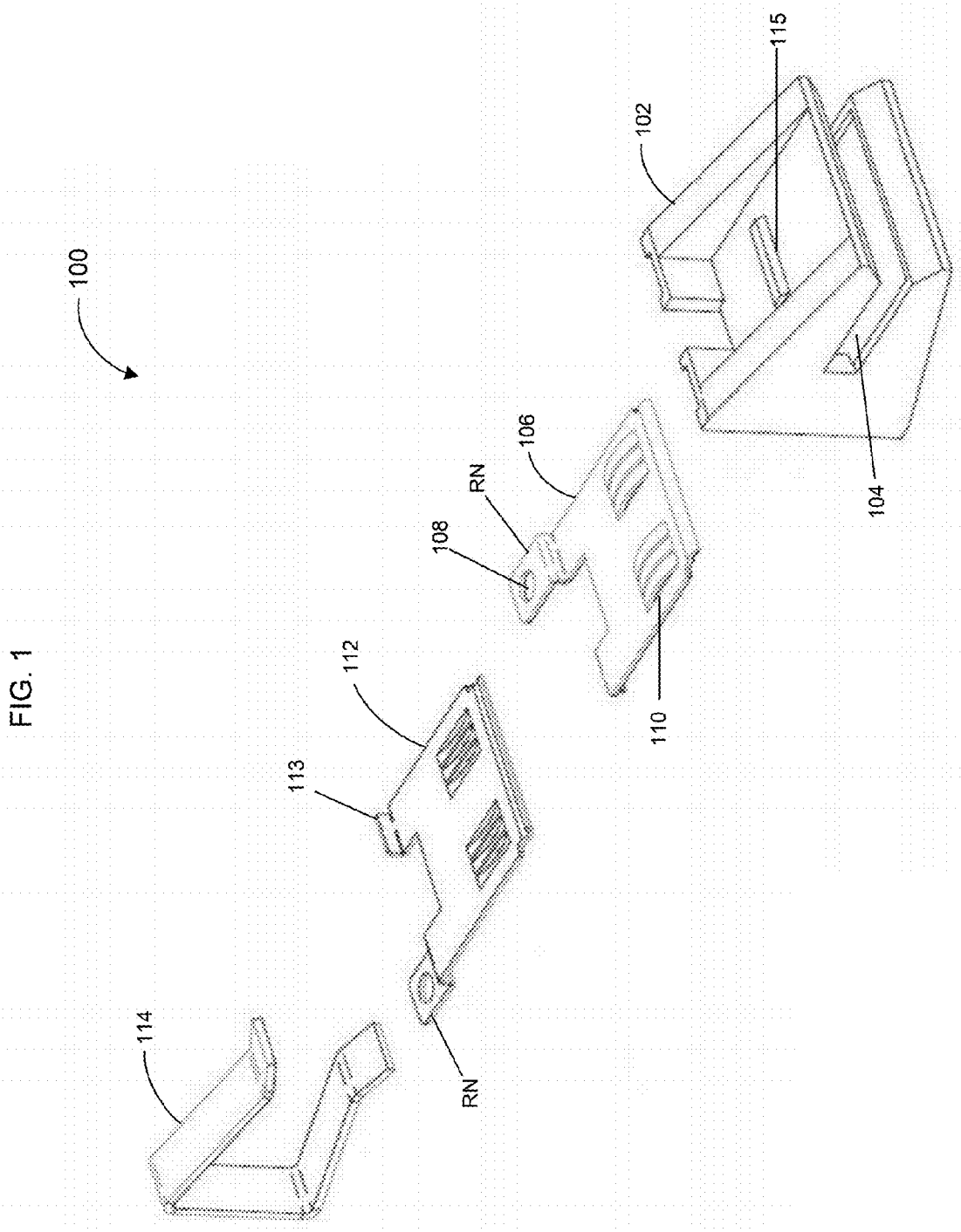
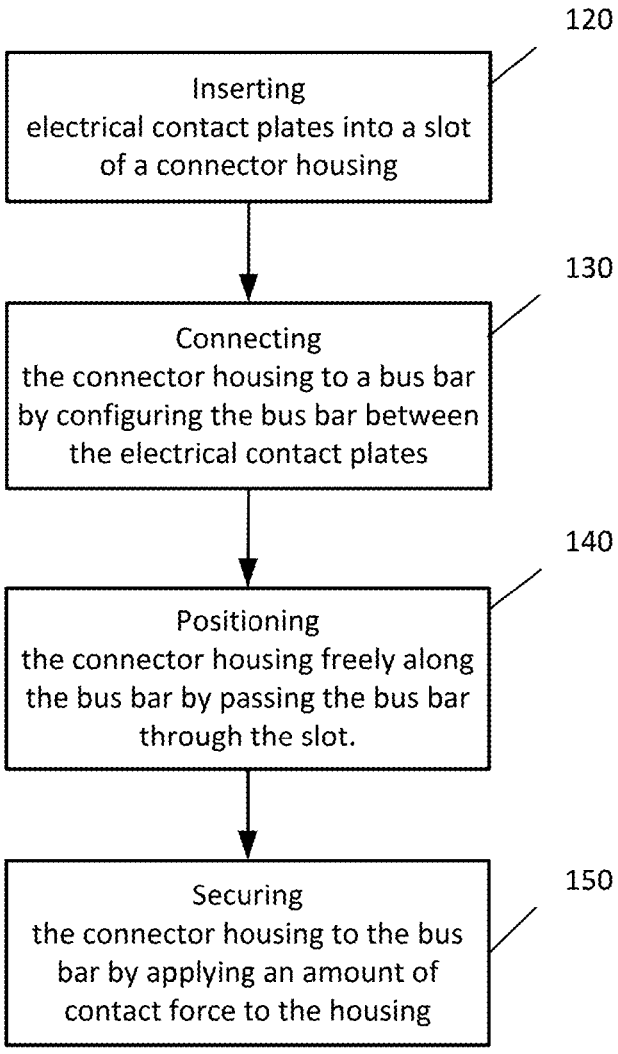


FIG. 1

FIG. 1A

100A


120
Inserting
electrical contact plates into a slot
of a connector housing
130
Connecting
the connector housing to a bus bar
by configuring the bus bar between
the electrical contact plates
140
Positioning
the connector housing freely along
the bus bar by passing the bus bar
through the slot.
150
Securing
the connector housing to the bus
bar by applying an amount of
contact force to the housing

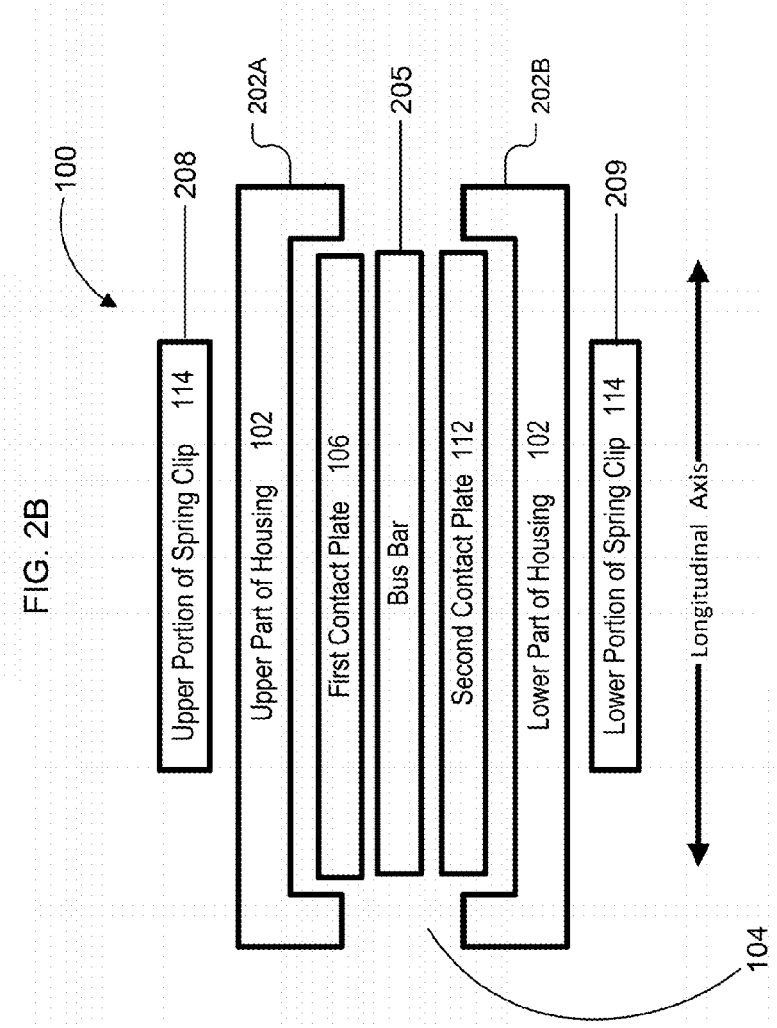

100
208
202A
205
202B
209
Upper Portion of Spring Clip 114
Upper Part of Housing 102
First Contact Plate 106
Bus Bar
Second Contact Plate 112
Lower Part of Housing 102
Lower Portion of Spring Clip 114
Longitudinal Axis
104

FIG. 2B

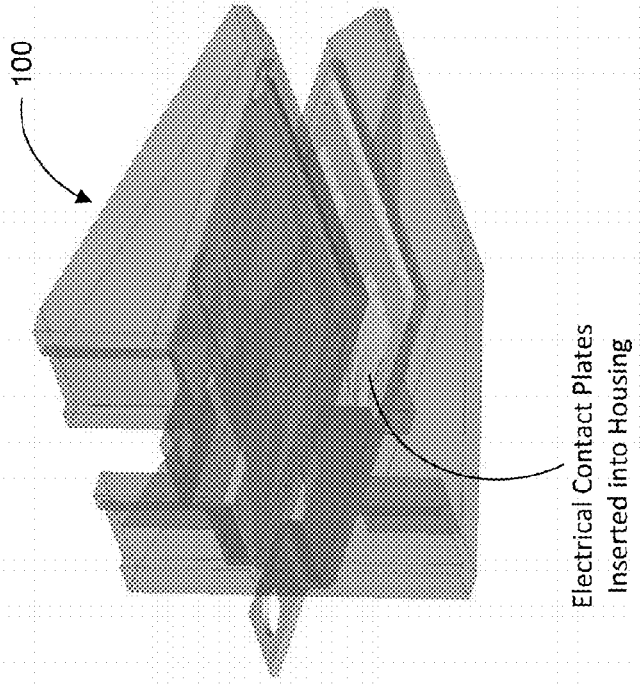

100
Electrical Contact Plates
Inserted into Housing

FIG. 2A

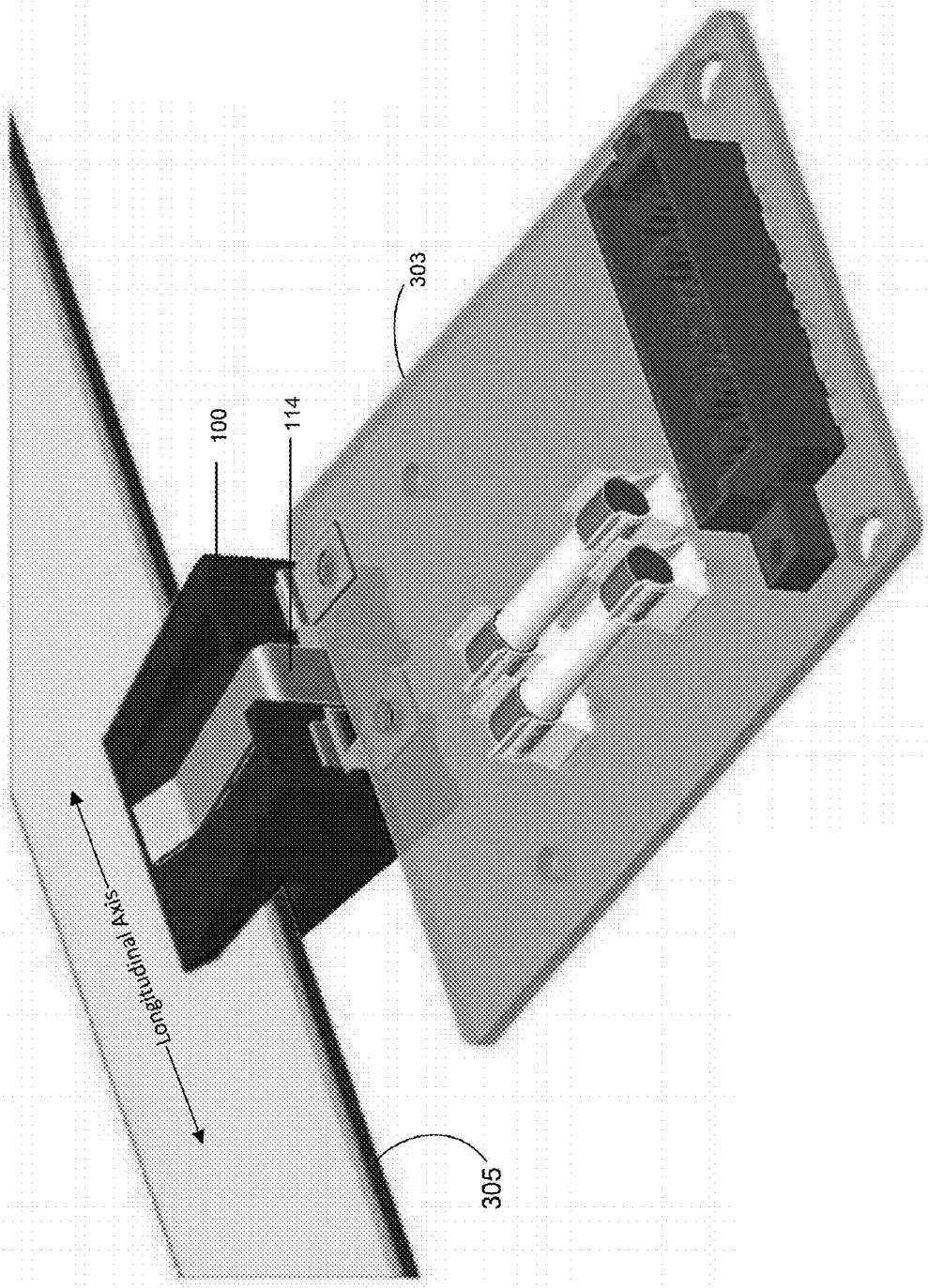


FIG. 3

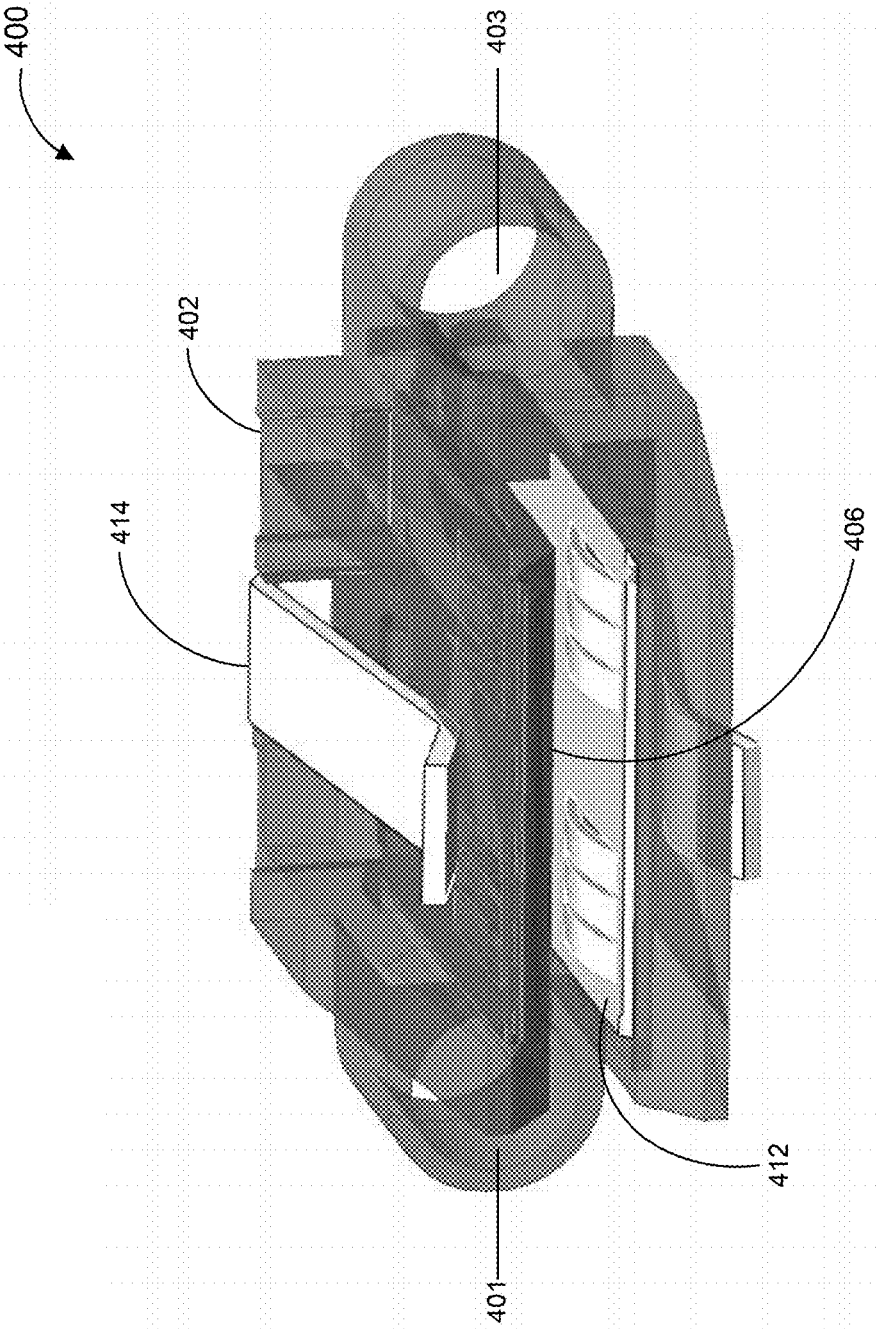


FIG. 4

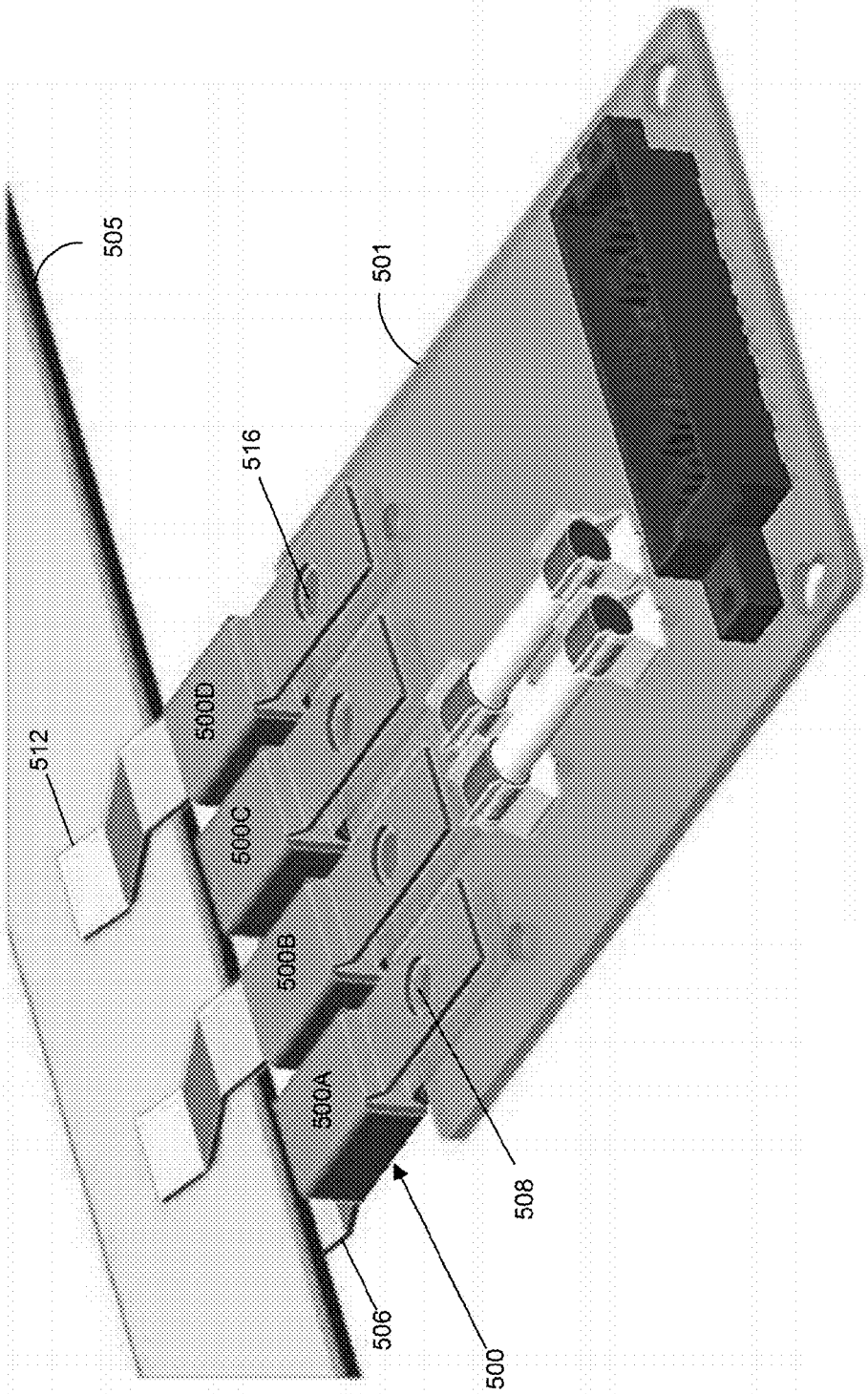


FIG. 5

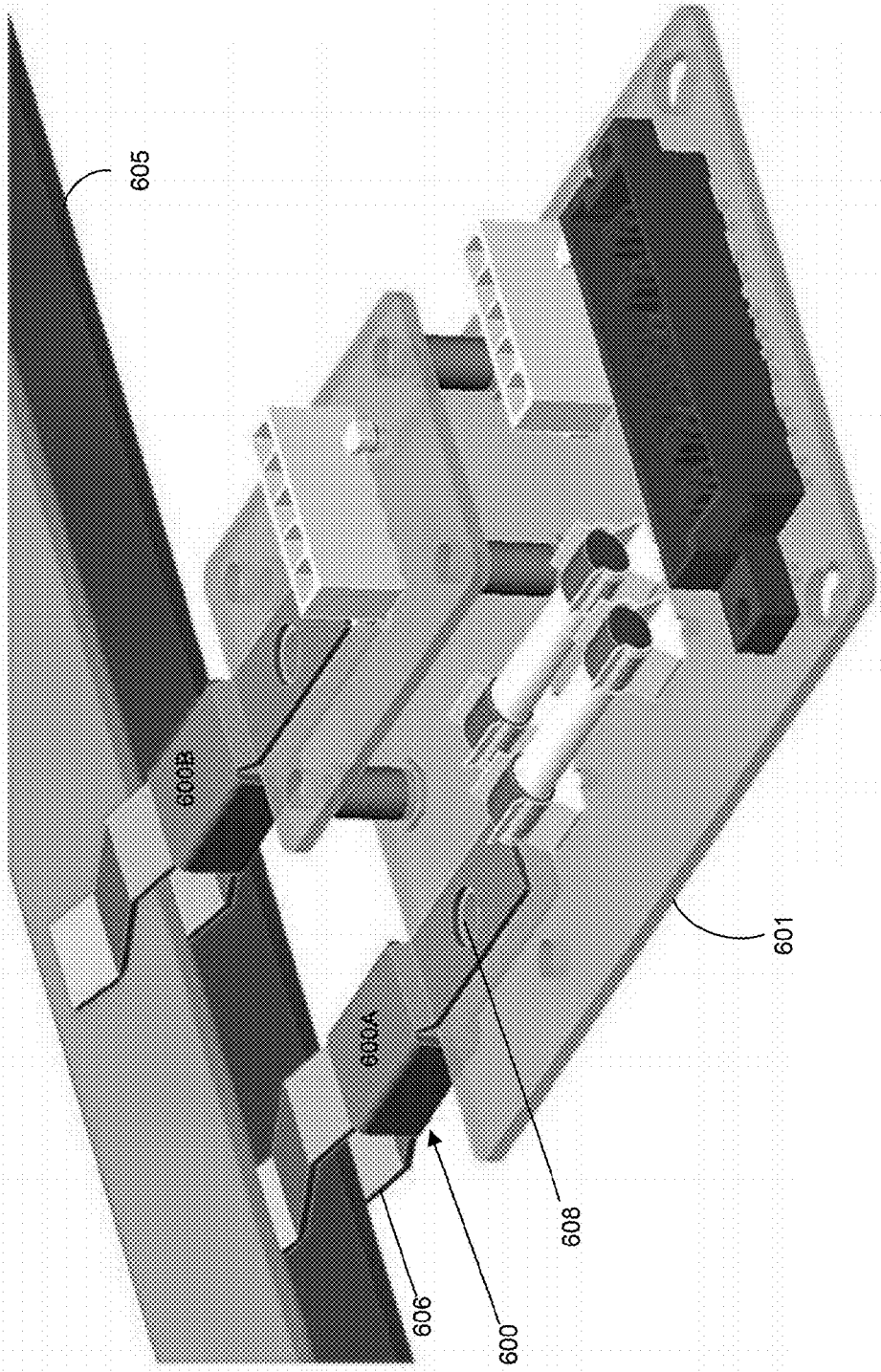
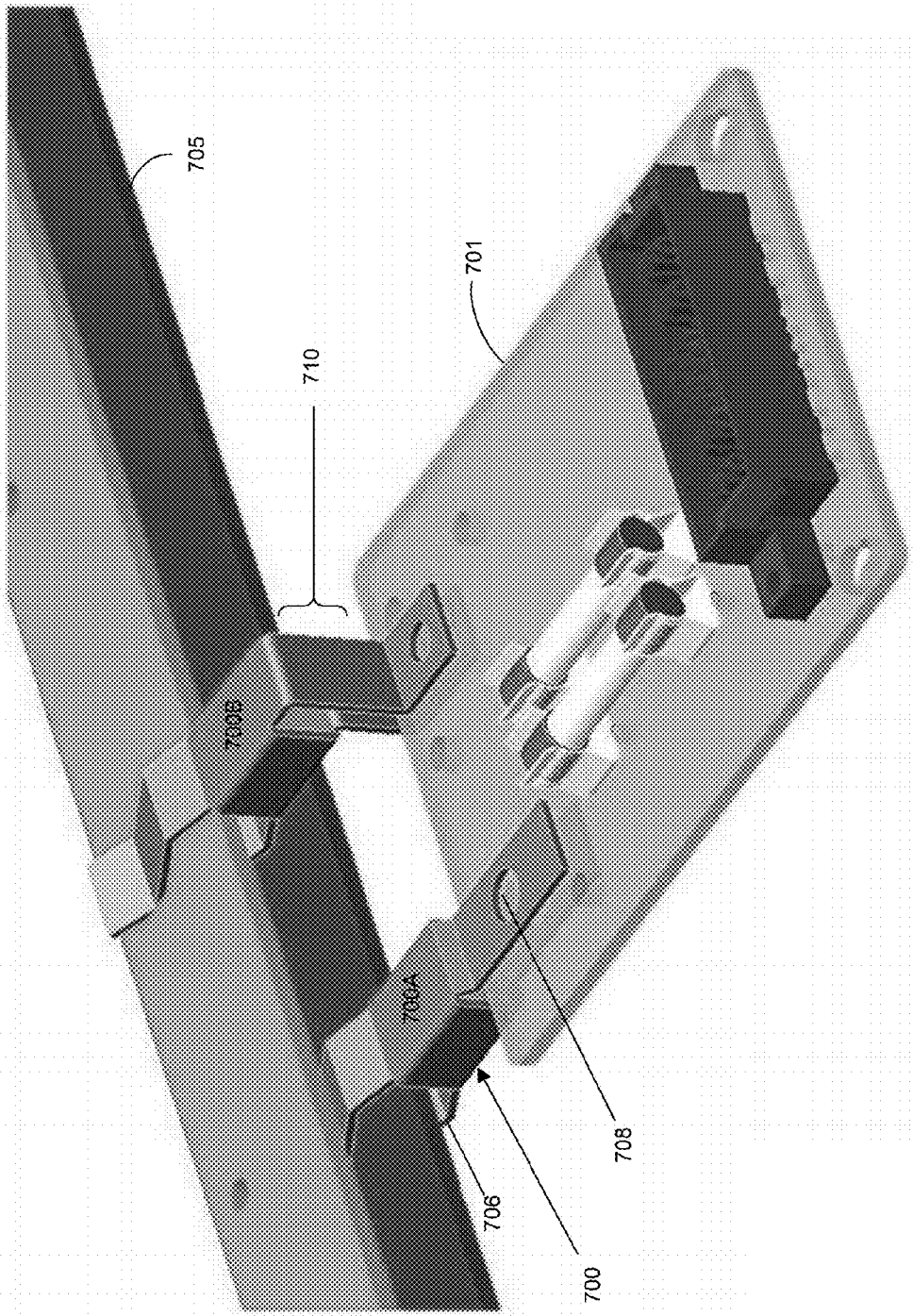


FIG. 6

FIG. 7



PITCH AGNOSTIC BUS-BAR WITH PITCH AGNOSTIC BLIND MATE CONNECTOR

BACKGROUND

In electrical power distribution, bus bars are strips of material (e.g., copper) used to conduct electricity within an apparatus, such as a distribution board, switchboard, and substation. These bus bars are designed to distribute electricity to separate components connected to the apparatus. Typically, the apparatus may be pre-configured at certain locations to facilitate connections between the bus bar and the separate components. However, some components of different shapes and sizes are unable or rather difficult to connect to a bus bar at these pre-configured locations.

BRIEF SUMMARY

Aspects of the disclosure may be advantageous for providing various bus bar connectors configured to draw power from a bus bar at non-discrete locations. One aspect of the present technology provides a bus bar connector. The bus bar connector includes a connector housing having a slot. The slot can be configured to allow the connector housing to grip a bus bar at different locations. First and second electrical contacts are disposed on opposite sides of the slot. The bus bar connector includes mounting members for securing the connector housing against an enclosure for the bus bar. The bus bar connector also includes a spring clip configured to attach to upper and lower outer surfaces of the connector housing to provide an amount of contact force onto the outer surface of the connector housing. The amount of contact force may enable the first and second electrical contacts to securely grip the bus bar.

In one example, the mounting members may include rear contacts attached to the connector housing. The rear contacts may be adapted to accept mounting lugs for securing the housing to the enclosure.

In one example, the first and second electrical contacts include contact fingers. The contact fingers are configured on a surface of each electrical contact facing the bus bar to increase gripping power of the connector housing onto the bus bar.

In one example, the first and second electrical contacts include a ring terminal configured on a tab portion of each contact. The ring terminal may be configured to receive an electrical component.

In one example, the first and second electrical contacts include a terminal positioned on a tab portion of each contact, the terminal being configured to receive a wiring component to attach one or more wires to the first and second electrical contacts.

Another aspect of the present technology provides a system. The system includes a bus bar for supplying current from a power supply to a device and a bus bar connector. The bus bar connector includes a housing having a slot. The slot can be configured to allow the housing to grip the bus bar at different locations. First and second electrical contacts disposed on opposite sides of the slot. In this regard, the bus bar can be configured between the first and second electrical contacts. The bus bar connector includes mounting members for securing the connector housing against an enclosure for the bus bar. The bus bar connector also includes a spring clip configured to attach to upper and lower outer surfaces of the connector housing to provide an amount of contact force onto the outer surface of the connector housing. The amount of contact force may enable the first and second electrical contacts to securely grip the bus bar.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded perspective view of an example of a bus bar connector in accordance with one aspect.

FIG. **1**A is an example of a flow diagram in accordance with one aspect.

FIG. **2**A is an example of an assembled bus bar connector in accordance with one aspect of the disclosure.

FIG. **2**B is a cross sectional diagram of an assembled bus bar connector in accordance with one aspect.

FIG. **3** is an example of an assembled bus bar connector connected to a bus bar in accordance with aspects of the disclosure.

FIG. **4** is an example of a bus bar connector including panel-mounting features in accordance with one aspect of the disclosure.

FIG. **5** is an example of a bus bar connector connecting an electrical component to a bus bar in accordance with one aspect of the disclosure.

FIG. **6** is another example of a bus bar connector connecting an electrical component to a bus bar in accordance with one aspect of the disclosure.

FIG. **7** is yet another example of a bus bar connector connecting an electrical component to a bus bar in accordance with one aspect of the disclosure.

DETAILED DESCRIPTION

Aspects, features and advantages of the disclosure will be appreciated when considered with reference to the following description of embodiments and accompanying figures. The same reference numbers in different drawings may identify the same or similar elements. Furthermore, the following description is not limiting; the scope of the present technology is defined by the appended claims and equivalents. While certain processes in accordance with example embodiments are shown in the figures as occurring in a linear fashion, this is not a requirement unless expressly stated herein. Different processes may be performed in a different order or concurrently. Steps may also be added or omitted unless otherwise stated.

The subject matter of the present disclosure generally relates to creating a flexible bus bar connector that can draw power from a bus bar at non-discrete locations. This can allow electronic components and other types of payloads connected to an apparatus, such as a distribution board, to have the flexibility to vary in widths and sizes by being able to freely attach to the bus bar along any position.

FIG. **1** is an exploded perspective view of an example of a bus bar connector **100**. In this example, the bus bar connector **100** includes a housing **102** for accommodating various parts of the bus bar connector **100**. The housing **102** can be a type of synthetic or non-synthetic polymer (e.g., a glass-filled nylon or plastic) that provides stability and a degree of flexibility when force is applied. According to aspects, the housing **102** may be configured to receive a bus bar, such as a laminated bus bar comprised of two strips of an electrically conductive material (e.g., copper) with an insulator between them where power can be carried on one of the strips and a return path (e.g., ground) on the other. The bus bar can provide an electrical power source to a plurality of electrical components attached to the bus bar connector **100**.

In order to receive a bus bar, the bus bar connector **100** may include a slot **104**. As shown in FIG. **1**, the bus bar housing **102** includes a slot **104** that extends along a longitudinal axis of the housing **102**. When the housing is matted with a bus bar, the slot **104** may be parallel to a longitudinal axis of the bus bar (not shown). In some aspects, the slot **104** may be adapted to allow the bus bar to pass through the housing **102**. For example, upon receiving a bus bar at slot **104**, the housing **104** can be moved along the bus bar by passing the bus bar through the slot **104** along the longitudinal axis of the housing **102**.

The bus bar connector **100** may be configured to make electrical contact with the bus bar. For example, as shown in FIG. **1**, the bus bar connector **100** also includes a first electrical contact plate **106** capable of conducting electricity. The first electrical contact plate **106** includes a ring terminal **108** configured on a rear tab portion RN of the plate **106**. This terminal **108** can be adapted to receive a type of ring fastener (not shown) that holds an electrical component, such as a printed circuit board (PCB), server, computing device or other types of devices requiring an electrical current, onto the plate **106**. From the ring terminal **108**, power can be feed, for example, to a connected electrical component that returns through the bus bar connector **100**.

In order to make electrical contact with the bus bar, the bus bar connector **100** also includes a second electrical contact plate **112** similar to the first electrical contact plate **106**. For example, the second electrical contact plate **112** also includes a ring terminal configured on a rear tab portion RN of the plate **112**. The second electrical contact plate **112** differs in that it is oriented opposite to corresponding portions of the first electrical contact plate **106**.

In some aspects, the electrical contact plates can be adapted to receive a wiring component (such as O-ring wire connector that includes electrical insulation surrounding one or more wires or other types of wire connectors), which may be capable of accepting one or more wires. In this way, the bus bar connector **100** can be configured from being a board-mounted connector, such as a connector for matting a PCB onto a bus bar, to a cable-mounted connector. For example, a terminal (not shown) can be configured on the rear tab RN portion of the first and second electrical contact plates **106** and **112**. In this example, the terminal may receive a wiring component that can attach one or more wires to each plate.

According to aspects, each electrical contact plate can also include contact fingers or ridges. As shown in the example of FIG. **1**, the first electrical contact plate **106** includes a number of contact fingers **110** arranged on a surface of the plate **106** which may be facing the bus bar. An advantage of the contact fingers **108** is that they can increase gripping strength of the contact plate when held against the bus bar. This process of engaging contact plates for gripping a bus bar is further described below.

To facilitate matting of the bus bar connector **100** with a bus bar, the electrical contact plates of the connector may be inserted into the slot **104** and configured opposite to each other. For example, the first electrical contact plate **106** may be inserted into slot **104** below the second electrical contact plate **112**. In some aspects, the first and second electrical contact plates **106** and **112** may include a stopper device to ensure the contact plates as inserted correctly. In this regard, the stopper device can include a stopper **113** that may indicate when a particular contact plate has been fully inserted into the housing **102**. For example, upon insertion of the electrical contact plates **106** and **112** into housing **102**, the stopper device may engage a part of the housing **102** indicating that the contact plates are fully inserted. Having the contact plates fully inserted into the housing **102** can ensure a maximum level of electrical contact with the bus bar when the bus bar connector **100** is matted with the bus bar.

The first and second electrical contact plates **106** and **112** can be held against or otherwise grip opposite sides of a bus bar passing between the plates through slot **104**. For example, a means of applying an amount of contact force to the housing **102** can be employed to bring the two respective contact plates into electrical contact with the bus bar, thereby making a full electrical circuit between the bus bar and an electrical component attached to the bus bar connector **100**.

For applying a desired amount of clamping force (e.g., approximate 25 lbs) to the housing **102** for gripping a bus bar, the bus bar connector **100** may also include a spring clip **114**. For example, the housing **102** can be configured to allow insertion and removal of the spring clip **114**. In some aspects, the spring clip **114** may be received at respective connector groves positioned on the housing **102**. As shown in FIG. **1**, for example, the housing **102** may include a grove **115** for receiving the spring clip **114** configured on an upper and lower outer surface of the housing **102**.

The spring clip **114** may be a material such as a lightweight metal or another type of resilient material that can be repetitively flexed and returns to an original position after manipulation. In addition to proving an amount of clamping force, an advantage of the spring clip is that it can be used to prevent creeping (e.g., a tendency of a solid material to move slowly or deform over time) of the housing **102** on the bus bar.

FIG. **1**A is an example of a flow diagram **100**A for example, of how the bus bar connector **100** of FIG. **1** may be assembled.

At block **120**, electrical contact plates are fully inserted into a slot in a connector housing. For example, the first and second electrical contact plates **106** and **112** are inserted into slot **104** of the housing **102**, whereby the contact plates are positioned on opposite sides of the slot **104**.

At block **130** the connector housing may be connected to a bus bar by configuring the bus bar between the electrical contact plates. For example, the bus bar connector **102** may be matted with a bus bar by fitting the bus bar into the housing **102** through slot **104** so that the housing **102** holds the bus bar between the first and second electrical contact plates **106** and **112**.

At block **140**, the connector housing may be freely positioned along the bus bar by passing the bus bar through the slot. For example, the housing **102** holding the bus bar may be freely positioned along a longitudinal axis of the bus bar by passing the bus bar through the slot **104**.

At block **150**, the connector housing may be secured to the bus bar by applying an amount of contact force (e.g., lbs) to the housing. During assembly of the bus bar connector **100**, an amount of clamping force may be applied to the housing **102** using, for example, spring clip **114**, such the housing **104** is secured to the bus bar.

FIGS. **2**A-**2**B are examples of assembled bus bar connectors, for example, FIG. **2**A is an assembled bus bar connector **100** and FIG. **2**B is a cross-sectional diagram of an assembled bus bar connector **100**. Although in these examples a particular contact plate is illustrated as being placed on top of the other, the contact plates may be configured in various orientations, for example, by rotating a longitudinal axis of the housing **102**. In this way, the contact plates may be configured vertically or horizontally with respect to an orientation of a longitudinal axis of a bus bar passing through the housing **102** between the plates.

As shown in FIG. **2**B, bus bar **205** may be disposed between the first contact plate **106** and the second contact plate **112** inside of a slot **104** of the housing **102**. As discussed

above, an amount of contact force can be applied to the housing **102** in order for the assembled bus bar connector **100** to grip the bus bar **205**. For example, spring clip **114** may have an upper and lower portion **208** and **209** configured so that the upper portion **208** rests on an upper part of the housing **202**A while the lower portion **208** rests on lower part of the housing **202**B, opposite of **202**B. In some aspects, the spring clip **114** can adjust from a first position (e.g., an original position) to a second position (e.g., the upper and lower portions **208** and **209** bending outwards in opposite directions) which allows the clip **114** to be placed over the housing **102**. As the spring clip **114** reforms back to the first position, force is applied to respective parts of the housings **102** thereby holding the first and second contact plates **106** and **112** against the bus bar **205**.

In FIG. **3**, an example of an assembled bus bar connector **100** connected to a bus bar **305** is shown. According to aspects, the assembled bus bar connector **100** may be connected to the bus bar **305** at various locations along the bus bar **305**. For example, the connector can be laterally arranged freely along a longitudinal axis of the bus bar **305** by passing the bus bar though a slot in the connector **100**. Once positioned, the bus bar connector **100** may be held against the bus bar **305**, for example, by using spring clip **114**. In this example, upon connecting the assembled bus bar connector **100** to bus bar **305**, a power current may begin flowing from the bus bar **305** through the connector **310** to an attached electrical component **303**.

FIG. **4** is an illustration of a bus bar connector **400** including panel-mounting features. In this example, the bus bar connector **400** is configured similar to connector **100** from FIG. **1**. For example, connector **400** includes a housing **402**, electrical contact plates **406** and **412** disposed within a slot **404** of the housing **402**, and a spring clip **414** similar to the housing **102**, electrical contact plates **106** and **112**, slot **114** and spring clip **114**. As with spring clip **114**, spring clip **414** can be configured to apply force on the housing **412** to hold the connector **400** to a bus bar. In one aspect, the panel-mounting features may comprise mounting brackets **401** and **403**, which can be configured at each side of the housing **402**. The panel mounting features may allow the housing **402** to be attached, for example, to a sheet metal chassis or other material used as a housing for a bus bar. Each mounting bracket can be adapted to receive a threaded or non-threaded mounting lug (not shown), which can be screwed or otherwise inserted into that mounting bracket for securing the housing **402** to the chassis. Although the panel-mounting features (e.g., mounting brackets **401** and **403**) are illustrated in FIG. **4** at opposite sides of the housing **402**, these features may be configured at different positions on the housing **402** as necessary for securing the housing **402** in place.

FIG. **5** is an example of a bus bar connector **500** connecting an electrical component **501** to a bus bar **505**. In this example, the connector **500** includes a plurality, here four, of individual sub-connectors **500**A-D, where sub-connector **500**A is equivalent to sub-connector **500**C and sub-connector **500**D is equivalent to sub-connector **500**B. As shown in FIG. **5**, bus bar sub-connector **500**A includes an electrical contact portion **506** capable of conducting electricity and a ring terminal **508** configured on a rear tab portion of the sub-connector **500**A. In some aspects, the ring terminal **508** can be in communication with the electrical component **501**.

Bus bar connector **500** also includes bus bar sub-connector **500**D having an electrical contact portion **512** and a ring terminal **516** configured on a rear tab portion. The bus bar sub-connector **500**D differs from sub-connector **500**A in that the electrical contact portion **512** is oriented opposite to corresponding portions of the electrical contact portion **506** of the bus bar sub-connector **500**A.

According to aspects, the electrical contact portions **504** and **510** (and those of sub-connectors **500**B and **500**C) may be adapted to receive the bus bar **505**. For example, contact portions of the bus bar sub-connectors can flex so that bus bar **505** can freely pass between them. In this regard, each contact portion may be a type of resilient material that can be repetitively flexed and returns to an original position after manipulation.

The contact portions can flex from a first position (e.g., an original position) to a second position (e.g., bending backwards) thereby allowing the bus bar to be positioned in between the contact portions. As the contact portions return back to the first position, they may hold or otherwise grip the bus bar **505** at a location. Thereupon, current may begin flowing from the bus bar **505** to the connected electrical component **501**. For example, a power current may flow through the bus bar sub-connector **500**D to the connected electrical component **501** and return through the bus bar sub-connector **500**A.

In FIG. **6**, another example of a bus bar connector **600** connecting an electrical component **601** to a bus bar **605** is shown. As with FIG. **5** above, connector **600** includes a plurality, here two, of individual sub-connectors **600**A-B, where sub-connector **600**A is equivalent to sub-connector **600**B. Each bus bar connector includes an electrical contact portion **606** comprising first and second electrical contact plates (which can be compared to the first and second electrical contact plates **106** and **112** of FIG. **1**) that are capable of conducting electricity, and a ring terminal **608** (which can be compared to the ring terminal **108** of FIG. **1**) configured on a rear tab portion of the connector. In some aspects, the ring terminal **608** can be in communication with the electrical component **601**.

According to aspects, the bus bar connector **602** can be configured to receive the bus bar **605**. For example, the first and second electrical contact plates can be configured to create a slot where a portion of bus bar **605** can freely pass through. To position a portion of the bus bar **605** within the slot, the contact plates can flex from a first position (e.g., an original position) to a second position (e.g., outwardly in opposite directions) thereby allowing the slot to be able to receive the bus bar **605**. In this regard, the electrical contact plates are a type of resilient material that can be repetitively flexed and returns to an original position after manipulation. As the contact plates return back to the first position, they can grip the bus bar **605** at different locations. In some aspects, current may begin flowing from the bus bar **605** to the connected electrical component **601**. For example, a power current may flow through bus bar connector **608** to the connected electrical component **601** and return through the bus bar connector **602**.

In FIG. **7**, yet another example of a bus bar connector **700** connecting an electrical component **701** to a bus bar **705** is shown. As with FIGS. **5** and **6** above, connector **700** includes a plurality, here two, of individual sub-connectors **700**A-B. Each bus bar connector includes an electrical contact portion **706** comprising first and second electrical contact plates (which can be compared to the first and second electrical contact plates **106** and **112** of FIG. **1**) capable of conducting electricity, and a ring terminal **708** (which can be compared to the ring terminal **108** of FIG. **1**) configured on a rear tab portion of the connector. The ring terminal **708** can be in communication with the electrical component **701**.

In some aspects, the bus bar sub-connectors can include an extension portion **710** configured between the electrical contact and rear tab portion of the sub-connectors.

According to aspects, the bus bar sub-connectors **700**A-B may be configured to receive bus bar **705**. For example, the first and second electrical contact plates can be configured to create a slot where a portion of the bus bar **705** can freely pass through. To position a portion of the bus bar **705** within the slot, the contact plates can flex from a first position (e.g., an original position) to a second position (e.g., outwardly in opposite directions) thereby allowing the slot to be able to receive the bus bar **705**. As the contact plates return back to the first position, they may hold or otherwise grip the bus bar **705**. In some aspects, current may begin flowing from the bus bar **705** to the connected electrical component **701**. For example, a power current may flow through bus bar sub-connector **700**B to the connected electrical component **701** and return through the bus bar sub-connector **700**A.

As these and other variations and combinations of the features discussed above can be utilized without departing from the disclosure as defined by the claims, the foregoing description of the embodiments should be taken by way of illustration rather than by way of limitation of the disclosure as defined by the claims. It will also be understood that the provision of examples of the disclosure (as well as clauses phrased as "such as," "e.g.", "including" and the like) should not be interpreted as limiting the disclosure to the specific examples; rather, the examples are intended to illustrate only some of many possible embodiments.

The invention claimed is:

1. A bus bar connector, comprising:

a connector housing having a slot, the slot being configured to allow the connector housing to grip a bus bar at different locations;

first and second electrical contact plates disposed on opposite sides of the slot, the first and second electrical contact plates each including a plurality of contact fingers, the contact fingers being arranged on opposing surfaces of the first and second electrical contact plates facing the bus bar;

mounting members for securing the connector housing against an enclosure for the bus bar; and

a spring clip configured to attach to upper and lower outer surfaces of the connector housing, the spring clip being adjustable between at least a first original position and a second position in which upper and lower portions of the spring clip bend outwards in opposite directions, the spring clip configured to provide an amount of contact force onto the outer surface of the connector housing, the amount of contact force causing the contact fingers on the first and second electrical contact plates to securely grip the bus bar.

2. The bus bar connector of claim **1**, wherein the mounting members include rear contacts attached to the connector housing.

3. The bus bar connector of claim **2**, wherein the rear contacts are configured to accept mounting lugs for securing the housing to the enclosure.

4. The bus bar connector of claim **1**, wherein the first and second electrical contact plates include a ring terminal configured on a tab portion of each contact, the ring terminal being configured to receive an electrical component.

5. The bus bar connector of claim **1**, wherein the first and second electrical contact plates include a terminal positioned on a tab portion of each contact, the terminal being configured to receive a wiring component to attach one or more wires to the first and second electrical contacts.

6. The bus bar connector of claim **1**, wherein the housing is configured to allow insertion and removal of the spring clip.

7. The bus bar connector of claim **1**, wherein the upper and lower outer surfaces of the connector housing include grooves for receiving the spring clip.

8. The bus bar connector of claim **7**, wherein the grooves comprise a raised portion of the housing, the grooves extending along the upper and lower outer surfaces of the housing perpendicular to a longitudinal axis of the spring clip.

9. The bus bar connector of claim **1**, wherein the amount of contact force provided by the spring clip onto the outer surface of the housing is approximately 25 lbs.

10. The bus bar connector of claim **1**, wherein the housing further comprises first and second raised portions at respective back ends of the upper and lower outer surfaces of the housing, the raised portion extending perpendicularly with respect to the respective upper and lower outer surfaces, and each of the first and second raised portions including a recess corresponding in size and shape to the spring clip.

11. The bus bar connector of claim **1**, wherein the spring clip includes a back edge connecting the upper and lower portions such that the upper and lower portions are angled towards each other from the back edge to a front section in the first original position.

12. The bus bar connector of claim **11**, wherein only the front section of the spring clip maintains contact with the upper and lower outer surfaces of the housing.

13. A system, comprising:

a bus bar for supplying current from a power supply to a device; and

a bus bar connector comprising:

a housing having a slot, the slot being configured to allow the housing to grip the bus bar at different locations;

first and second electrical contact plates disposed on opposite sides of the slot, the first and second electrical contact plates each including a plurality of contact fingers, the contact fingers being arranged on opposing surfaces of the first and second electrical contact plates facing the bus bar;

mounting members for securing the connector housing against an enclosure for the bus bar; and

a spring clip configured to attach to upper and lower outer surfaces of the connector housing, the spring clip being adjustable between at least a first original position and a second position in which upper and lower portions of the spring clip bend outwards in opposite directions, the spring clip configured to provide an amount of contact force onto the outer surface of the housing, the amount of contact force causing the contact fingers on the first and second electrical contact plates to securely grip the bus-bar.

14. The system of claim **13**, wherein the mounting members include rear contacts attached to the housing.

15. The system of claim **14**, wherein the rear contacts are configured to accept mounting lugs for securing the housing to the enclosure.

16. The system of claim **13**, wherein the first and second electrical contacts include a ring terminal configured on a tab portion of each contact, the ring terminal being configured to receive an electrical component.

17. The bus bar connector of claim **13**, wherein the first and second electrical contacts include a terminal positioned on a tab portion of each contact, the terminal being configured to receive a wiring component to attach one or more wires to the first and second electrical contact plates.

18. The system of claim **13**, wherein the housing is configured to allow insertion and removal of the spring clip.

19. The system of claim **13**, wherein the upper and lower outer surfaces of the connector housing include grooves for receiving the spring clip.

20. The system of claim **13**, wherein the amount of contact force provided by the spring clip onto the outer surface of the housing is approximately 25 lbs.

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